

Space-borne low frequency radar sounding: An Engineering Perspective

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So far, the planetary explorations have primarily focused on gathering information about the surface of the planets. Recently, due to current speculations of the existence of underground water reservoirs on Mars and possibility of an ocean beneath the Europa's icy surface, there is a growing interest in space-borne radio sounders. Europa orbiter which is currently in the planning stage is considering a radar sounder as one of its science instruments. This paper will focus on the work done on MARSIS (Mars Advanced Radar for Subsurface and Ionospheric Sounding) which is the first of this new generation of radio sounders. It will arrive at Mars in early 2004 for a two-year mission.

MARSIS is the result of an international collaboration between NASA, the Italian Space Agency (ASI), and European Space Agency (ESA), is designed to sense planets interior to a depth of up to 5 km. MARSIS' main objective is to search for water if it exists in liquid form under the surface. It will also attempt to map and characterize the subsurface geological structure of Mars, which is hidden under a layer of surface dust. In addition to its subsurface exploration goals, MARSIS will study the ionosphere of Mars providing the most extensive amount of data on Martian ionosphere to date. MARSIS is a challenging project and its design is pushing the envelope in all aspects including transmitter design, light-weight antenna design and on-board processing. MARSIS is designed with a high relative bandwidth of one MHz at a frequency range from 0.2 MHz to 5.5 MHz with five distinct operating 1 MHz sub-bands. Also, since operation at low frequency is dictated by the need to penetrate deep below the surface of Mars, MARSIS has to be capable of dealing with distortions that are introduced by the ionosphere. Also due to limitations in the data transfer rate, a significant amount of on-board signal processing is required to reduce the data redundancy and maintain a reasonable data rate in order to achieve the goal of global coverage. This presentation will provide an overview of the space-borne low-frequency radar sounding, its capabilities and its future.